IN THE CLAIMS

Amendments to the claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of claims:

Claims 1-33 (Canceled).

34. (New) A method for determining a volume of formation cut by each one of a plurality of roller cones on a drill bit drilling in earth formations, comprising:

selecting bit design parameters, comprising at least a geometry of a cutting element on the drill bit;

selecting at least one characteristic of an earth formation to be simulated as being drilled by the drill bit;

simulating drilling of the earth formation, the simulating comprising calculating from the selected bit design parameters and the selected earth formation characteristic, parameters for a crater formed when each one of a plurality of cutting elements on each of the roller cones contacts the earth formation, the parameters including at least a volume of the crater;

simulating incrementally rotating the bit, and repeating the calculating of the crater parameters for a selected number of incremental rotations; and

combining the volume of each crater formed by each of the cutting elements on each of the roller cones to determine the volume of formation cut by each of the roller cones.

35. (New) A method for balancing a volume of formation cut by each one of a plurality of roller cones on a drill bit drilling in earth formations, comprising:

selecting bit design parameters, comprising at least a geometry of a cutting element on the drill bit;

selecting at least one characteristic of an earth formation to be simulated as being drilled by the drill bit;

simulating drilling of the drill bit through the earth formation, the simulating comprising calculating from the selected bit design parameters and the selected earth formation characteristic, parameters for a crater formed when each one of a plurality of cutting elements on each of the roller cones contacts the earth formation, the parameters including at least a volume of the crater;

simulating incrementally rotating the bit, and repeating the calculating of the crater parameters for a selected number of simulated incremental rotations;

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combining the volume of each crater formed by each of the cutting elements on each of the roller cones to determine the volume of formation cut by each of the roller cones; and

adjusting at least one of the bit design parameters, and repeating the calculating the crater volume, incrementally rotating and combining the volume simulating until a difference between the combined volume cut by each of the cones is less than the combined volume determined prior to the adjusting the at least one of the bit design parameters.

36. (New) A method for determining an axial force acting on each one of a plurality of roller cones on a roller cone drill bit during drilling, comprising:

simulating drilling of an earth formation by the roller cone bit, the simulating comprising calculating, from a geometry of cutting elements on each of the roller cones and at least one characteristic of an earth formation being drilled by the drill bit, an axial force acting on each of the cutting elements;

simulating incrementally rotating the bit and recalculating the axial forces acting on each of the cutting elements;

repeating the simulating the incrementally rotating and recalculating for a selected number of incremental rotations; and

combining the axial force acting on the cutting elements on each one of the roller cones to determine the axial force acting on each of the roller cones.

37. (New) The method as defined in claim 16 wherein the axial force acting on each of the cutting elements totals an axial force applied to the drill bit.

38. (New) The method as defined in claim 17 wherein the volume of each of the craters is determined by:

determining an axial force on each of the cutting elements;

calculating, from the axial force on each of the cutting elements, an expected depth of penetration and projected area of contact between each of the cutting elements and the earth formation; and

calculating the volume of each of the craters from the expected depth of penetration and projected area of contact.

39. (New) The method as defined in claim 18 further wherein the axial force acting on each of the cutting elements totals an axial force applied to the drill bit.

40. (New) A method for balancing axial forces acting on each one of a plurality of roller cones on a roller cone drill bit during drilling, comprising:

simulating the drill bit drilling through an earth formation, the simulating comprising calculating, from a geometry of cutting elements on each of the roller cones and at least one characteristic of an earth formation simulated as being drilled by the drill bit, an axial force acting on each of the cutting elements,

simulating incrementally rotating the bit and recalculating the axial forces acting on each of the cutting elements; repeating the incrementally rotating and recalculating for a selected number of simulated incremental rotations;

combining the axial force acting on the cutting elements on each one of the roller cones; and

adjusting at least one bit design parameter, and repeating the simulating until a difference between the combined axial force on each one of the roller cones is less than a difference between the combined axial force determined prior to adjusting the at least one initial design parameter.

41. (New) The method as defined in claim 20 wherein the axial force acting on each of the cutting elements totals an axial force applied to the drill bit.

42. (New) The method as defined in claim 20 wherein the at least one bit design parameter comprises a number of cutting elements on at least one of the cones.

43. (New) The method as defined in claim 20 wherein the at least one bit design parameter comprises a location of cutting elements on at least one of the cones.

44. (New) The method as defined in claim 15 wherein the at least one bit design parameter comprises a number of cutting elements on at least one of the cones.

45. (New) The method as defined in claim 15 wherein the at least one bit design parameter comprises a location of cutting elements on at least one of the cones.

46. (New) A method for optimizing a design of a roller cone drill bit, comprising:

simulating the bit drilling through a selected earth formation;

adjusting at least one design parameter of the bit, the at least one design parameter comprising a parameter selected from the group of a number of cutting elements on each one of a plurality of roller cones, cutting element type, and a number of rows of cutting elements on each one of the plurality of roller cones;

repeating the simulating the bit drilling; and

repeating the adjusting and simulating until an optimized design is determined.

47. (New) A method for optimizing a design of a roller cone drill bit, comprising:

simulating the bit drilling through a selected earth formation;

adjusting at least one design parameter of the bit;

repeating the simulating the bit drilling; and

repeating the adjusting and simulating until a rate of penetration of the bit through the selected earth formation is maximized.

48. (New) A method for optimizing a design of a roller cone drill bit, comprising:

simulating the bit drilling through a selected earth formation;

adjusting at least one design parameter of the bit;

repeating the simulating the bit drilling; and

repeating the adjusting and simulating until an axial force on the bit is substantially balanced between the roller cones.

49. (New) A method for optimizing a design of a roller cone drill bit, comprising:

simulating the bit drilling through a selected earth formation;

adjusting at least one design parameter of the bit;

repeating the simulating the bit drilling; and

repeating the adjusting and simulating until a volume of formation cut by the bit is substantially balanced between the roller cones.

50. (New) A method for optimizing a design of a roller cone drill bit, comprising:

simulating the bit drilling through a selected earth formation;

adjusting at least one design parameter of the bit;

repeating the simulating the bit drilling; and

repeating the adjusting and simulating until an optimized design is determined, wherein the simulating comprises:

selecting bit design parameters;

selecting drilling parameters;

selecting an earth formation to be represented as drilled;

calculating from the selected parameters and the formation, parameters for a crater formed when one of a plurality of cutting elements on the bit contacts the earth formation, the cutting elements having known geometry;

calculating a bottomhole geometry, wherein the crater is removed from a bottomhole surface;

incrementally rotating the bit;

repeating the calculating of the crater parameters and the bottomhole geometry based on calculated roller cone rotation speed and geometrical location of the cutting elements with respect to rotation of the bit about its axis.